

the bottom of the gauge, or the sloping funnel of the receiver, so far below the mouth of the gauge that drops and spatter and hailstones can not easily bound out and be lost.

In order to catch and measure hail separate from the water, or in order to prevent the hail from melting and becoming indistinguishably mixed with the rain, some special form of gauge is needed, such as has not yet been invented and we commend this problem to the ingenuity of our readers. A layer of some soft substance at the bottom of a simple cylindrical gauge, such as we use for catching snow, would probably prevent the loss of the hail by the rebound or the breaking of the hail by a violent shock, but it would not prevent the melting of the hail by the rain that usually falls with it. As an experiment we think it would be worth while to try a separate special hail collector to consist of a cylindrical bag, 5 or 8 inches in diameter and 2 feet long, hanging freely suspended from a firm ring or hoop fastened horizontally between two posts at a few feet above the ground. The wind will deflect such a bag from the vertical, so that hail falling into it will be apt to strike the sides and glide to the bottom with diminished momentum without breaking; the rain that falls will of course pass through the bag without melting much of the hail, and, in fact, if the observer is at hand, he can rescue the hail and measure it promptly before much loss has occurred.

One of the curious phenomena with regard to hailstones is the fact that at the center each stone includes a bubble of gas under very great pressure. It is worth while to melt hailstones in a mixture of soap and water, and observe the relative diameters of the bubbles of air when inside the hailstones, and again after they have been liberated. The sudden expansion of the bubbles as they escape has been found to indicate that the air is imprisoned under a pressure of several atmospheres. This could only happen in case the hailstone is made of water that has been frozen from the outside inward, thus driving its imprisoned air to the center. Another evidence of the pressure existing within a hailstone is said to be shown by examining the optical properties of a section, as can easily be done by using a beam of polarized light.

IGNIS FATUUS OR JACK-O'-LANTERN.

This title is given to flickering flames and dancing balls of fire seen at nighttime in marshy places. The phenomenon appears to be rare in the United States, but common in some parts of Europe, probably owing largely to geological peculiarities as affecting the nature of surface soil. The light is undoubtedly caused essentially by the slow oxidation of gases containing some combination of phosphorus. Such gases, of course, result from the decomposition of animal and, more rarely, of vegetable matter. This is probably the explanation of a phenomenon recorded in the Evening News of Detroit, April 6, as having been observed near Lee, Mich. The newspaper account says:

Between 10 and 11 o'clock the other night a bright light was seen emerging from the river [possibly the Kalamazoo River in southeastern Michigan]. On first sight it was thought to be a lantern, but further investigation proved it to be a ball of light about as large as a large hen's egg floating through the air, about 10 feet from the ground, with whizzing sound and zigzag motion. It soon disappeared.

Although, under some circumstances, there occurs a form of lightning electric discharge known as "ball lightning," yet it is not likely that this was the case in the present instance. Both the ball lightning and the ignis fatuus belong to the rare and curious phenomena of meteorology. Although they have no important relation to climatology or to dynamic meteorology, yet they are always worthy of record. From the standpoint of the electrician, ball lightning is a phenomenon whose nature is as yet totally unknown, and a satisfactory explanation thereof is greatly desired.

CURRENT WEATHER AND FUTURE CROPS.

An average state of weather is expected to produce an average crop and when some condition that seems abnormal occurs, the people are full of apprehension that the crops will be greatly diminished and of inferior quality; prices go up, speculation is rife, and the croakers have it all their own way. But after a few weeks nature restores the injury that was done, and before Thanksgiving day comes around those early fears are all dissipated by the sight of the bountiful crops. The really serious injuries to the crops almost invariably occur late in the growing season, when there is no time left to repair the damage.

Mr. J. M. Broadfield publishes several illustrations of this principle in a letter to Mr. George E. Hunt, Director of the Georgia Climate and Crop Service, and published in the Georgia Review for June 15, 1896. Mr. Broadfield says:

The year 1818 was very fatal to all crops; no rain from the last of March till August; 1839, no rain from the 1st of April till 3d of July, and every farmer gave it up, that it was impossible to make but little, if anything. But the rains set in the 3d of July, and it rained every day for two weeks, and, to the astonishment of all, more cotton was made that year than any previous one. Corn took on new life, and a very heavy crop was made. In 1845 the drought set in about the last of March or 1st of April, and no rain till middle of August. Farmers planted corn, peas, turnips, etc., after rain set in, and made enough to fatten hogs—from the late planting. I remember we had no frost that fall till 28th of November.

April and May, 1896, were the next most remarkable departures from the normal weather conditions.

SECULAR CHANGES IN CLIMATES AND CROPS.

The meteorologist appeals to his records of observations in order to detect any change in climate, but the agriculturist naturally puts more faith in the appeal to the records of crops and vegetation. The latter may be called a practical test of the permanency of climate, but it is also very liable to be a deceptive one. The thermometer is a very simple instrument compared with a plant. The records of freezing temperatures apply directly to the climate while the records of frost-bitten plants must be interrupted by taking into consideration the nature of the plant, its stage of development, the moisture in the ground, the dryness and windiness of the air. The principal uncertainty with regard to the record of a thermometer relates to our possible ignorance of its height above the ground and the extent to which it is shielded from radiation of heat. On the whole it must be confessed that the imperfections of thermometric records are quite serious and that when it comes to a question of what the climate was fifty or a hundred years ago phenology has about as much weight as thermometry.

But any record of any climatic feature is sure to show a wide range of extremes in the course of fifty years, and the question of a real change in climate can not be settled by quoting a few such extremes. It has been well pointed out by Professor Bailey, in the MONTHLY WEATHER REVIEW for September, 1896, p. 330, that phenological records have no special value to the botanist or botanical physiologist, but their proper use is to determine average climatological conditions. If, for instance, we knew the average date of leafing or blooming or ripening of any plant for the past fifty years, and again for the preceding fifty years, the comparisons of these averages, having proper regard to the index of annual variability, would give as clear an idea of the possible change in climate as if we had corresponding records of the temperature, sunshine, and rainfall. It is true that the climate has made the plant, and that if we knew enough about the physiology of plants, we might utilize meteorological records to explain botanical peculiarities, but, practically, we can not do this with any safety. The phenologist must be allowed to consider his observations of plants as being a record of